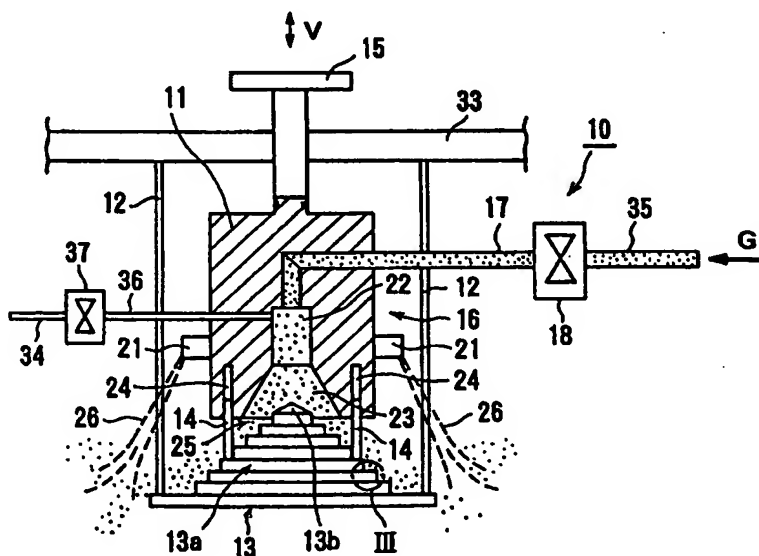




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : B05B 1/26, 7/00, 15/04	A1	(11) International Publication Number: WO 98/28086 (43) International Publication Date: 2 July 1998 (02.07.98)
(21) International Application Number: PCT/JP97/04780 (22) International Filing Date: 24 December 1997 (24.12.97) (30) Priority Data: 196 54 321.5 24 December 1996 (24.12.96) DE (71) Applicant: EBARA CORPORATION [JP/JP]; 11-1, Haneda Asahi-cho, Ohta-ku, Tokyo 144 (JP). (72) Inventors: HESSELBACH, Jens; Limburgstrasse 122, D-73265 Dettingen (DE). KARLE, Heinz; Haldenwangstrasse 4, D-76227 Karlsruhe (DE). (74) Agents: WATANABE, Isamu et al.; Aoyagi Building #501, 39-11, Chuo 5-chome, Nakano-ku, Tokyo 164 (JP).		(81) Designated States: CN, ID, JP, KR, SG, VN. Published <i>With international search report.</i>

(54) Title: APPARATUS FOR AEROSOL CREATION



(57) Abstract

An apparatus for aerosol creation in particular in a cooling, lubricating apparatus for tools or work piece comprises an injector apparatus to which a carrier gas and a fluid may be supplied. At an outlet (23) of the injector apparatus, a gas jet (25) with fluid droplets therein exits that is directed onto a deflection body (13) with a structured surface and that streams along same. The deflection body can, for example, be formed by a cone or a truncated cone with a step-shaped shell (coating surface). In order to be able to vary the particle size, the distance between the deflection body and the outlet of the injector apparatus can be variable.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakhstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

DESCRIPTION
APPARATUS FOR AEROSOL CREATION

Technical Field

5 The present invention relates to an apparatus for aerosol creation in particular in a cooling, lubricating apparatus for tools or work pieces with an injector apparatus, to which a carrier gas and a fluid are supplyable and which gives off a gas jet with fluid droplets contained therein at an outlet.

10

Background Art

 Aerosols find application in many areas of technology, in which respect, for example, reference should be made to inhalators in medical technology, air humidifiers in the area
15 of household technology, the application of cleaning or protection agents, etc. It is further known to use aerosols for cooling or lubricating a tool or a work piece, which is the exemplary basis of the follow discussion.

 Tools and work pieces are subject to high frictional forces
20 during machining, which leads to the development of large amounts of heat. It is thus necessary to reduce the friction of the aforementioned pieces via the application of a cooling lubrication medium (agent), through which the pieces are simultaneously cooled. Previously, it was typical to use full
25 jet cooling, which has been known for some time and during which the cooling lubrication agent is applied in relatively large amounts to the surfaces to be cooled in a full jet of fluid. In this case, however, a very large consumption of cooling lubrication agent results on the one hand, whence the operation
30 of the cooling, lubricating apparatus is expensive, and on the other hand, it is necessary for ecological reasons to dispose of the used cooling lubrication agent in an ecologically sound way, which is complicated and also expensive.

In the so-called minimal lubrication technique developed in the last years, a fluid cooling lubrication agent is atomized in a nozzle in an air stream. For this purpose, the fluid cooling lubrication agent and the air are fed to the nozzle in separate conduits (pipes, lines), wherein the air stream exiting from the nozzle at a relatively high velocity mixes with the cooling lubrication agent after exiting from the nozzle. Systems are also known, in which the creation of the mixed mist is carried out within the nozzle. The spray mist of the cooling lubrication agent-air mix is applied directly to the surfaces to be treated, whereby a good cooling and lubricating effect of the tools and work pieces can be achieved. It furthermore has the advantage that the consumption of cooling lubrication agent is significantly lowered and thus also the problem of disposal is lessened. However, the cooling lubrication agent mist created in the aforementioned manner is relatively inhomogeneous with regard to the size of the droplets. Although this is relatively unproblematic for so-called outer cooling, in which the cooling lubrication agent is applied from outside to the parts to be cooled, problems crop up during so-called inner cooling, in which the cooling lubrication agent mist is transported through inner channels running through the tool directly to the contact surface between the tool and the work piece. When the tool is rotated, larger droplets of the cooling lubrication agent mist are also brought into rotation and accelerated radially outwardly such that they accumulate on the walls of the channels. This leads to a non-uniform transport of the cooling lubrication agent and in particular to the creation of splashes. Similar problems occur when the cooling lubrication agent mist is to be transported through relatively long conduits.

From DE 30 34 941 A1, on which the preamble of claim 1 is based, it is known to additionally use an aerosol that contains very fine oil particles floating in the air stream for the cooling

and lubrication of rotating parts in addition to a conventional oil lubrication. To achieve this object, oil is sucked in from a supply by means of an air stream streaming through an injector nozzle and is atomized together with the air in an aerosol chamber, whereby the heavy oil particles that precipitate on the floor and the wall of the aerosol chamber flow back into the supply. In spite of the precipitation of the heavy oil particles, however, particles of various size still remain in the aerosol, whereby furthermore the particle composition and size cannot be changed in accordance with DE 30 34 941 A1. Thus, an adjustment of the cooling and lubricating behavior to the particular requirements that can differ depending on the type of material and processing is not provided for.

Disclosure of Invention

It is an object of the present invention to create an apparatus for aerosol creation with which an aerosol with small particle size can be reliably achieved.

In accordance with the present invention, this object is achieved in an apparatus for aerosol creation in that the gas jet is directed onto a deflection body with a structured surface and streams along same.

In the apparatus in accordance with the present invention, the lubricating fluid is sucked in in a known manner by means of a negative pressure and atomized in a jet of a carrier gas, preferably air. The carrier gas is fed under pressure into a chamber of the injector apparatus, whereby, due to the enlargement of the cross-section, a negative pressure is effected that transports the lubricating fluid from its conduit that also opens into the chamber and that gives the carrier gas stream its high velocity. The lubricating fluid is torn along with the carrier gas stream and precipitates, finely distributed, onto the structured surface of the deflection body. Since the

carrier gas stream streams over the structured surface of the deflection body with high velocity, it then atomizes the film of lubricating fluid forming on the structured surface into an aerosol of small particle size. Through corresponding formation
5 (design) of the structured surface, that comprises in particular a step structure, a very high aerosol concentration for low particle diameter can be achieved.

The size of the particles as well as the aerosol amount can preferably be changed in the apparatus for aerosol creation
10 in accordance with the present invention in that both the feeding in of the lubricating fluid as well as the feeding in of the carrier gas can be separately controlled via valves. Furthermore, the greasiness of the aerosol can be continuously varied (infinitely varied) in this manner.

The deflection body is arranged in front of the outlet
15 of the injector apparatus and is preferably formed as a rotationally symmetric body with a structured shell (coating surface). It has proven to be particularly feasible when the deflection body comprises a tapered form wherein it preferably
20 is conically pointed on its end facing the gas jet. Both a cone as well as a truncated cone can be used as a deflection body.

The tip of the cone or the narrow end of the truncated cone is preferably located directly at the outlet of the injector apparatus such that the gas jet impacts at this location on the
25 cone or truncated cone.

A further embodiment of the invention could be provided in that the outlet of the injector apparatus is conically widened in the direction of the flow of the gas jet. In this manner, the conically or truncated conically formed deflection body can
30 partially project into the outlet such that a streaming channel is formed between the inner wall of the outlet and the outer wall of the deflection body.

In particular, provision is made for the distance between

the deflection body and the outlet of the injector apparatus for the gas jet to be variable. In this manner, also the dimensions of the aforementioned streaming channel can be varied. It has been noted that, through variation of the distance, the particle size can be varied since the velocity of the gas jet is also varied in this manner. The higher the velocity of the gas jet is set, the finer the particle size of the created aerosol.

It has been noted that the concentration of the aerosol in the gas jet is dependent on the form of the structured surface, e.g. the step structure, of the deflection body. In particular, it is advantageous when each of the steps comprises an acutely angled turbulence edge, on account of which the lubricating fluid droplets are torn along by the gas jet in very small size. In this respect, in a further embodiment of the invention, the steps could comprise a cut back below their turbulence edges in order to achieve a particularly sharp turbulence edge.

A further embodiment of the invention provides for the steps to comprise a pointedly shaped projection along their turbulence edge that is preferably oriented against the stream of the gas jet.

To achieve an aerosol with approximately uniform particle size, the gas stream containing the aerosol is preferably filtered one or several times after streaming over a deflection body. In this respect, a sharp deflection of the gas stream can be seen as a filter as a result of which the heavy, and thus larger particles, are separated out. In addition to this mass or gravitational separation, a further embodiment of the present invention could provide for the gas stream streaming along the structured surface to be encompassed by an enveloping gas jet in particular of air. The enveloping gas jet, that can be created with a ring nozzle as is known in the art, accelerates the aerosol and thus assists the separation of larger particles whereas the finest particles can penetrate through the enveloping gas jet.

Alternatively, a sieve filter and/or a cyclone can be provided as a filtering apparatus. The latter can also be additionally formed as intermediate storage for the aerosol in order to be able to compensate variations in consumption.

5 In the apparatus in accordance with the present invention, the creation of the aerosol does not require any moving parts such that a high processing assurance is guaranteed. The amount of created aerosol depends on the (consumed) amount extracted by the consumer. If a lot of aerosol is consumed (extracted),
10 a corresponding amount of air then streams into the aerosol chamber whereby the inner pressure in the chamber remains constant and corresponds to the operating pressure set on a pressure reduction valve that precedes the chamber. The amount of aerosol creatable is thus dependent on the amount of air that
15 is fed into the system.

Brief Description of Drawings

Figure 1 shows a perspective view of a container of a cooling, lubricating apparatus with several associated tools
20 illustrated partly cut away;

Figure 2 shows a cross-section of an apparatus for aerosol creation;

Figure 3 shows detail III of Figure 2;

Figure 4 shows a first alternative embodiment of the steps
25 of Figure 3; and

Figure 5 shows a second alternative embodiment of the steps of Figure 3.

Best Mode for Carrying Out the Invention

30 Further details and features of the present invention can be seen from the following description of an embodiment as given in the drawings.

In accordance with Figure 1, a cooling lubricating

apparatus 30 comprises a container 31 that contains a supply 32 of fluid cooling lubrication agent, e.g. oil, in its lower portion. The container 31 is closed by a cover 33 and formed as a pressure container. In the space of the container 31 formed
5 above the oil supply 32, an aerosol is located that is formed in that a pressurized air stream is fed in via a conduit 35 in which a control valve 18 is located and via a further guiding conduit 17 of an injector apparatus 16. Due to the air stream streaming through the injector apparatus 16, a negative pressure
10 results, on account of which oil is sucked in from the supply 32 into the injector apparatus 16 via a vacuum conduit 34, an adjustment apparatus 37 that comprises a control valve 37b and a off-switch apparatus 37a for quickly switching off and a further guiding conduit 36. With the aid of the adjustment
15 apparatus 37, the volume stream (mass flow) of the oil into the vacuum conduit 34 can be infinitely variably controlled.

A connection conduit 38 is provided in the cover 33 of the container 31, through which the aerosol can be removed from the container 31 in order to use it, for example, for inner cooling.
20 The transportation of the aerosol through the connection conduit 38 can be carried out via the inner pressure in the container 31. In accordance with Figure 1, a suction jet 39 is additionally provided that supplies a conduit (not shown) with pressurized air. The air is fed into the suction jet 39 in the direction
25 of transportation such that the streaming of the air sucks up the aerosol, whereby the oil particles are again stirred up and accelerated.

The streaming aerosol A can, as indicated in Figure 1, be distributed to several branch conduits 27 and be supplied
30 through these to various tooling machines 28 with corresponding tools 29. Although Figure 1 illustrates inner cooling as an example, in which the aerosol is transported through channels running through the tool 29 and exiting at the tool tip, the

outer cooling known in the art can be used alternatively or additionally.

The apparatus 10 for aerosol creation is illustrated in detail in Figure 2. It comprises the injector apparatus 16 with an injector block 11 in whose inner space an injector chamber 22 is formed. The pressurized air G can be supplied to the injector chamber 22 via the conduit 35, the control valve 18 as well as the further guiding conduit 17. When entering into the injector chamber 22, as a result of the enlargement of the cross-section, a negative pressure results, as a result of which oil F is sucked into the injector chamber 22 via the suction conduit 34, the adjustment apparatus 37 and the further guiding conduit 36.

The injector chamber 22 is conically widened at its outlet 23 at which the pressurized exits as a gas jet 25 with fluid droplets contained therein.

Below the outlets 23, a cone-shaped deflection body 13 is located whose shell (coating surface) 13a comprises a step structure with a plurality of sequential steps 13c. The cone is oriented such that its tip 13b points toward the outlet 23 of the injector apparatus 16 and partially protrudes into the conically widened outlet 23.

The cone-shaped deflection body 13 is held via fixing rods 12 on the cover 33 of the container 31. The injector block 11 comprises an adjustment apparatus 15 in its upper section that penetrates through the cover 33 of the container 31 and through which the distance of the injector block 11 relative to the deflection body 13 can be changed (as indicated by the double-ended arrow V). During the adjustment motion, the injector block 11 is guided along several guide pegs 14 located on the deflection body 13 that displaceably engage in the respective cut-outs 24 of the injector block 11.

A ring jet 21 is located over the circumference of the injector block 11 that encompasses the gas jet 25, said ring

jet 21 giving off an enveloping air jet 26 that is directed downwardly. The gas jet 25 formed in the injector chamber 22 and its fluid droplets contained therein impacts onto the stepped surface 13a of the deflection body, as a result of which the fluid droplets first precipitate onto the step surfaces. The subsequent streaming air of the gas jet 25 then tears along finest droplets of the oil from the turbulence edges 13d of the steps 13c such that an aerosol with very fine oil particles results as a whole.

On the lower end of the deflection body 13, the aerosol stream is deflected on the side outwardly and thus undergoes a strong deflection that the heavy particles cannot follow and further fall downwardly into the oil supply 32. This is also assisted by the outer enveloping air jet 26 that tears along the larger particles and leads them back to the oil supply 32. The fine particles can penetrate through the enveloping air jet 26 and collect in the space above the oil supply 32.

For changing the size of the oil particles, the injector block 11 can be displaced relative to the deflection body 13. When the cross-section of the streaming channel formed between the tip 13b of the deflection body 13 and the conical outlet 23 is made smaller through a motion of the injector block 11 and the deflection body 13 in a direction towards one another, the streaming velocity of the gas jet 25 is increased, whence an aerosol with smaller particles results.

Although certain preferred embodiments of the present invention have been shown and described in detail, it should be understood that various changes and modifications may be made therein without departing from the scope of the appended claims.

Industrial Applicability

The present invention is suitable for use in a cooling, lubricating apparatus for tools or work pieces having an injector

apparatus, to which a carrier gas and a fluid are supplyable and which gives off a gas jet with fluid droplets contained therein at an outlet.

CLAIMS

1. An apparatus for aerosol creation in particular in a cooling, lubricating apparatus for tools or work pieces for an injector apparatus to which a carrier gas and a fluid are supplyable and which gives off a gas jet with fluid droplets contained therein at an outlet, characterized in that the gas jet (25) is directed at a deflection body (13) with a structured surface (13a) and streams along same.
2. The apparatus in accordance with claim 1 characterized in that the deflection body (13) comprises a step structure (13c).
3. The apparatus in accordance with claim 1 or 2 characterized in that the deflection body (13) is a rotationally symmetric body with a structured shell (coating surface).
4. The apparatus in accordance with any of claims 1-3 characterized in that the deflection body (13) comprises a form that tapers in the direction facing the gas jet (25).
5. The apparatus in accordance with claim 4 characterized in that the deflection body (13) is a cone or a truncated cone.
6. The apparatus in accordance with claim 5 characterized in that the gas jet impacts on the point of the cone or on the narrow end of the truncated cone.
7. The apparatus in accordance with any of claims 1-6 characterized in that the distance between the deflection body (13) and the outlet (23) of the injector apparatus (16) is

variable.

8. The apparatus in accordance with any of claims 1-7 characterized in that the outlet (23) is conically widened in the direction of flow of the gas jet (25).

9. The apparatus in accordance with any of claims 1-8 characterized in that the steps (13c) each comprises an acutely angled turbulence edge.

10. The apparatus in accordance with claim 9 characterized in that the steps (13c) comprise a undercut (13e) below their turbulence edge (13d).

11. The apparatus in accordance with claim 9 or 10 characterized in that the steps (13c) comprise a pointedly shaped projection (13f) along their turbulence edge (13d).

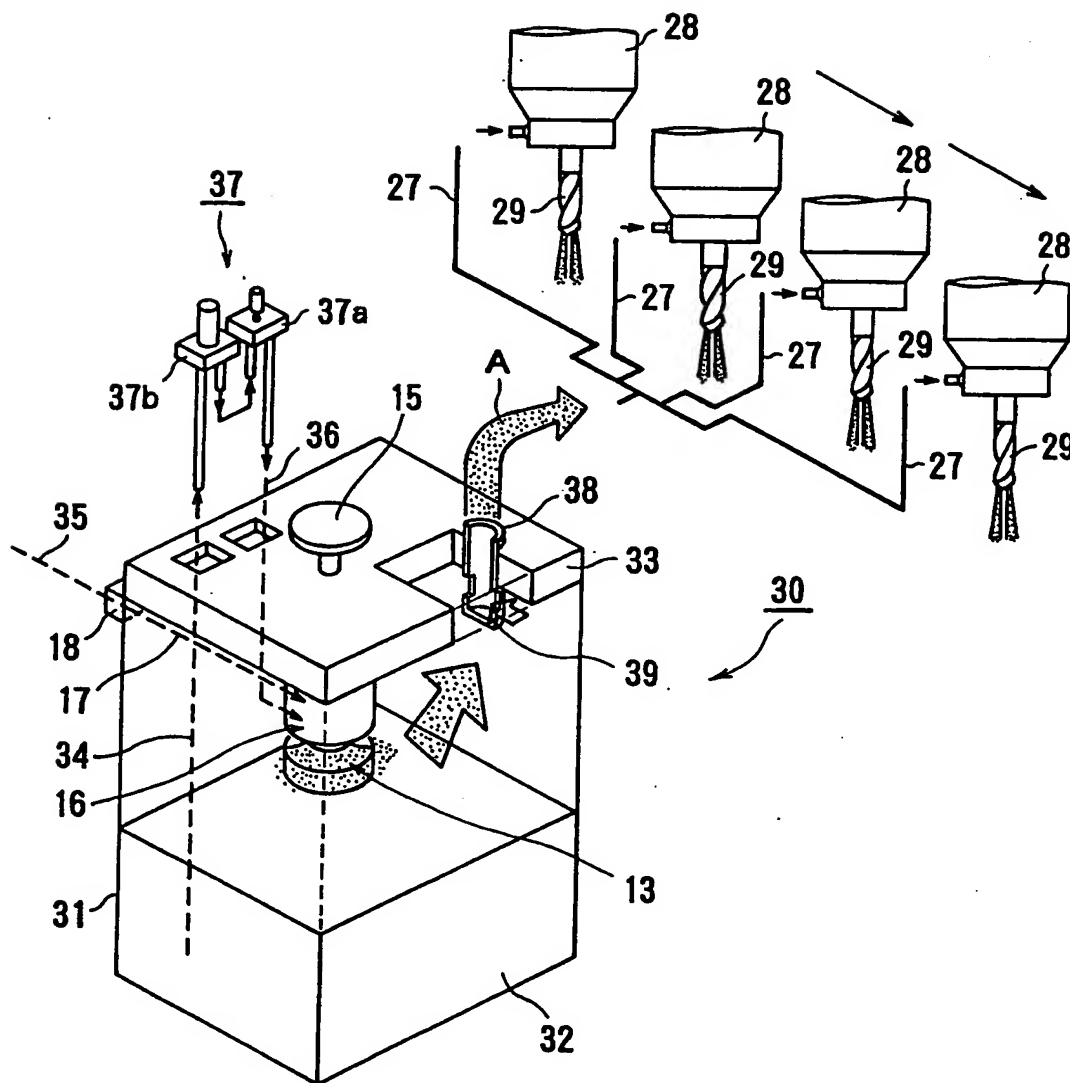
12. The apparatus in accordance with claim 1 characterized in that the projection (13f) is oriented against the streaming of the gas jet (13).

13. The apparatus in accordance with any of claims 1-12 characterized in that the gas jet (25) streaming along the structured surface (13a) is encompassed by an enveloping gas jet (26).

14. The apparatus in accordance with any of claims 1-13 characterized in that the gas jet (25) is sharply deflected after streaming over the deflection body (13).

1/2

FIG. 1



2/2

FIG. 2

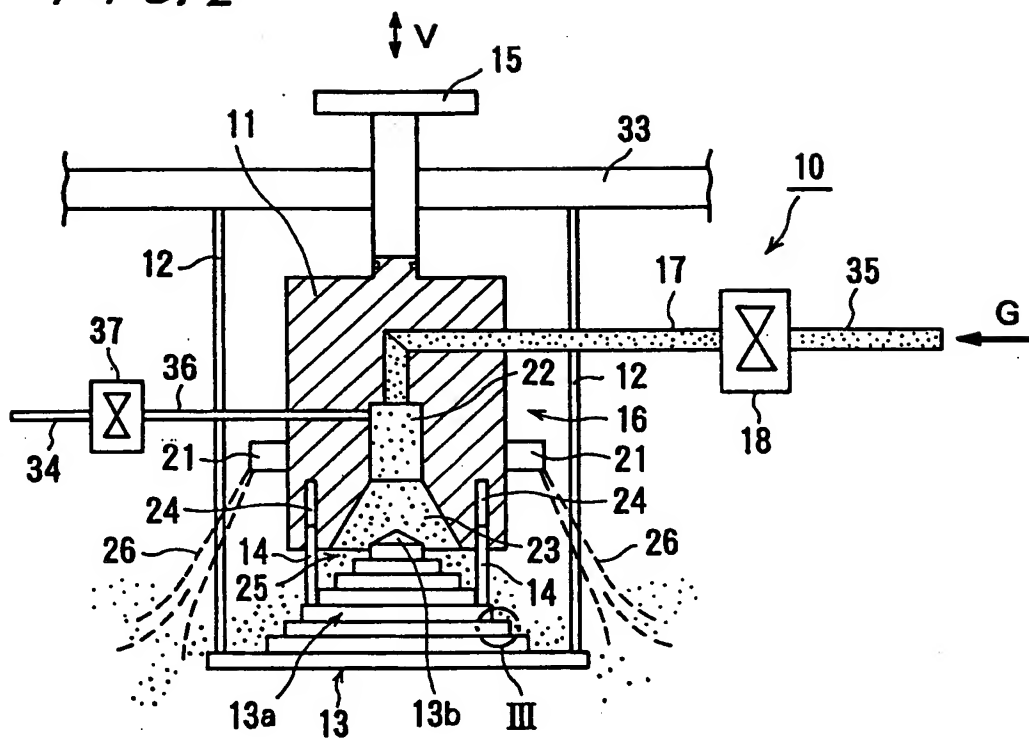


FIG. 3

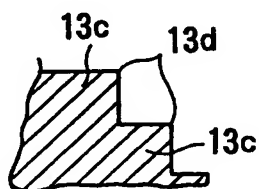


FIG. 4

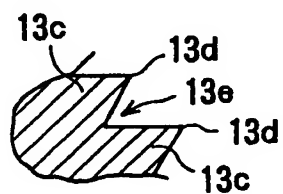
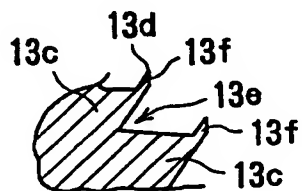


FIG. 5



INTERNATIONAL SEARCH REPORT

International Application No
PCT/JP 97/04780

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B05B1/26 B05B7/00 B05B15/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B05B F16N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 816 992 A (ALEC PATRICK JAMES) 22 July 1959 see the whole document ---	1-6, 9, 14
X	WO 91 16991 A (RESCH, LEMONS AND ERB) 14 November 1991 see page 28, line 21 - page 31, line 29; figures 8, 9 ---	1-9, 14
X	PATENT ABSTRACTS OF JAPAN vol. 18, no. 601 (C-1274), 16 November 1994 & JP 06 226145 A (WATANABE TOSHIYA), 16 August 1994, see abstract ---	1, 3-6
A	US 4 036 752 A (LASSITER) 19 July 1977 see column 2, line 23 - line 25 ---	7
-/-		

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search

16 February 1998

Date of mailing of the international search report

05/03/1998

Name and mailing address of the ISA
European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Guastavino, L

INTERNATIONAL SEARCH REPORT

Inte. onal Application No

PCT/JP 97/04780

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 166 790 A (F.E. GILL) 28 July 1921 see page 2, line 101 - line 113; figures 3,4 -----	9-12

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/JP 97/04780

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 816992 A		NONE	
WO 9116991 A	14-11-91	US 5232164 A	03-08-93
US 4036752 A	19-07-77	NONE	
GB 166790 A		NONE	

THIS PAGE BLANK (USPTO)